MINING WITH A DOSCO CONTINUOUS MINER ON A LONGWALL FACE

BY R. W. STAHL AND J. J. DOWD

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INTRODUCTION

One of the broad purposes of the Bureau of Mines since its establishment has been conservation of mineral resources. As some of the coal beds approach depletion, especially those coals suitable for making metallurgical coke, more and more attention is being given to means of recovering a larger percentage of coal in place. The customary system of mining in the United States is by room and pillar, or some variation thereof, which leaves pillars of coal to support the roof. In many operations, where the pillars are not systematically recovered, the loss of coal often amounts to 50 percent or more of the original deposit. In many instances in developing new mines, it is planned to recover chain and barrier pillars on retreat when the mine has reached established boundaries. Too often, however, mines are abandoned for some unforeseen reason before completion of mining without recovering any pillars. Usually, these pillars are lost forever.

With this in mind, the Mining Division, Region VIII, of the Bureau of Mines is encouraging mining by longwall methods. It is a generally known fact that almost all of the European coal is mined by longwall methods, which are conducive to a high percentage recovery of coal. A comparison between mining systems usually is on the basis of tons per man per shift. Unless all operating conditions are similar, such a comparison could be misleading. Generally, the output per man shift in European longwall mines is less than that obtained in room-and-pillar mining in the United States. In European mining, maximum recovery of coal is not only mandatory but it must be accomplished without major damage to surface by subsidence. These restrictions necessitate packing or stowing with consequential increases in manpower and decreases in output per man shift.

Longwall mining, especially the advancing longwall system, has been successful for many years in some coal fields in the United States. As in European practice, the production rate per man is small in comparison with rates by other systems of mining. Until recently, retreating longwall mining has not been successful because of failure to control the roof properly. Now that adjustable steel props are available in both the yielding and nonyielding types, adequate roof support plans can be developed. Within the last 2 years, several retreating longwall faces were mined with machines designed primarily for longwall work. One of these machines has been used to completely mine an experimental panel 328 feet wide and 1,441 feet long.[3] This machine also has mined two additional panels adjacent to the experimental panel and is mining now in a fourth panel. In each panel mined, the roof has been controlled at the face and permitted to break at the gob. Recovery of coal in the panels mined was 83 percent, as compared with 78 percent recovery by conventional methods. Only the chain pillars in the entries driven to develop the block of coal were not recovered.

Most of the present day continuous-mining machines have been designed for room-and-pillar mining and are used advantageously either in production or development. However, where a high percentage recovery of coal is desired and pillars are

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3/ Haley, W. A., Dowd, J. J., and Turnbull, L. A., Modified Longwall Mining With a German Coal Planer (Plow) in the Pocahontas No. 4 Coal Bed, Helen, W. Va.: Bureau of Mines Rept. of Investigations 4922, 1952, 13 pp.

extracted, much production time is lost while this type machine is being trammed from one working face to another. The Dominion Steel & Coal Corp., Ltd., Sydney, Nova Scotia, has developed and is using in longwall mining, continuous-mining machines[4] similar to the present day ripping-head type. This publication describes the operation of the machine and discusses the possible use of machines of this type on longwall faces in flat-lying coal beds.

ACKNOWLEDGMENTS

The authors wish to acknowledge with thanks the courtesies extended to them by the officials of the Dominion Steel & Coal Corp., Ltd., particularly H. C. M. Gordon, vice president and general manager, and Louis Frost, chief engineer, during the visit to the mines. Thanks are extended to the coal company officials for supplying photographs of the machine.

DESCRIPTION OF COAL BEDS AND OVERBURDEN

The Harbour bed and the underlying Phalen bed are each 72 inches thick, free of partings, medium hard, and do not part freely from the roof. The dip of the bed at each mine visited, where an operation was observed, is about 14 percent.

A drill-hole log of the overburden from surface to the Phalen bed was not available as the mine workings are under the Atlantic Ocean. However, a core from a vertical borehole from the Phalen bed, which was drilled upward 496 feet to probe for water in old workings, is said to be representative of the overburden over each coal bed. A section of the Phalen bed and overburden from this core is shown in figure 1.

MINE DEVELOPMENT

The main deeps (slopes) and airways are driven down the dip at right angles to the strike, leaving a 100-foot barrier pillar between the deeps and a 400-foot barrier pillar on either side of each airway, as shown in figure 2. Four adjacent 500-foot longwall faces are advanced simultaneously parallel with the strike from each side of the deep. These longwalls are planned to extend 8,500 feet to a designated boundary. On completion of mining of a block of four faces, the next deeper group is begun. No longwall mining is undertaken under less than 800 feet of overburden, and the depth of present mining under the sea is about 2,300 feet.

MINING EQUIPMENT

Continuous-Mining Machine

One continuous-mining machine is used on each 500-foot face. The crawler-mounted machine is 16 feet 7-3/4 inches long, 4 feet 6 inches wide, and 3 feet 9-3/4 inches high. (See fig. 3.) Seven ripping-type cutter chains are so spaced on the cutting head that the front end of the head is 4 feet 9 inches wide. (See fig. 4.) The chains are brought close together at the back end of the head; thus, the front of the head is wide enough to cut clearance for the main body of the machine. A variable-speed reversible rubber belt, moving transversely across the machine behind the cutter head, receives the mined coal and discharges it at the side of the machine onto a 30-inch belt conveyor. The machine controls are at the back end of the machine.

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[4] Frost, Louis, The Dosco Continuous Miner: Coal Mine Mod., Am. Min. Cong., 1952, pp. 123-129.

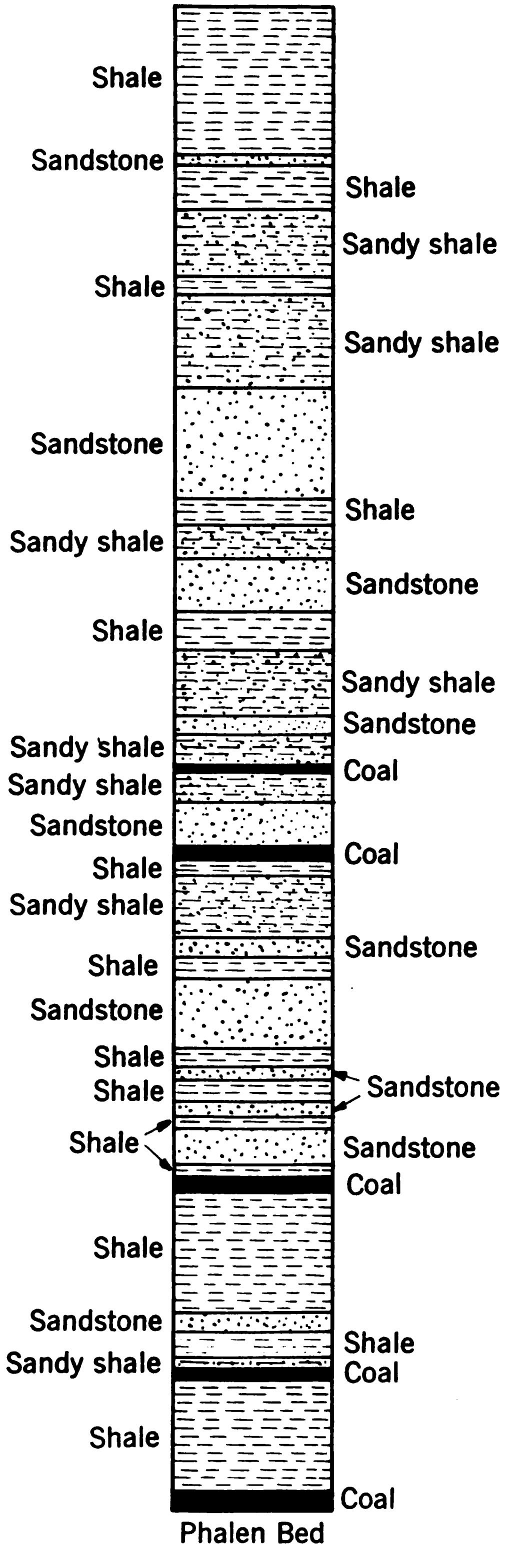

Figure 1. - Column of overburden on Phalen bed.

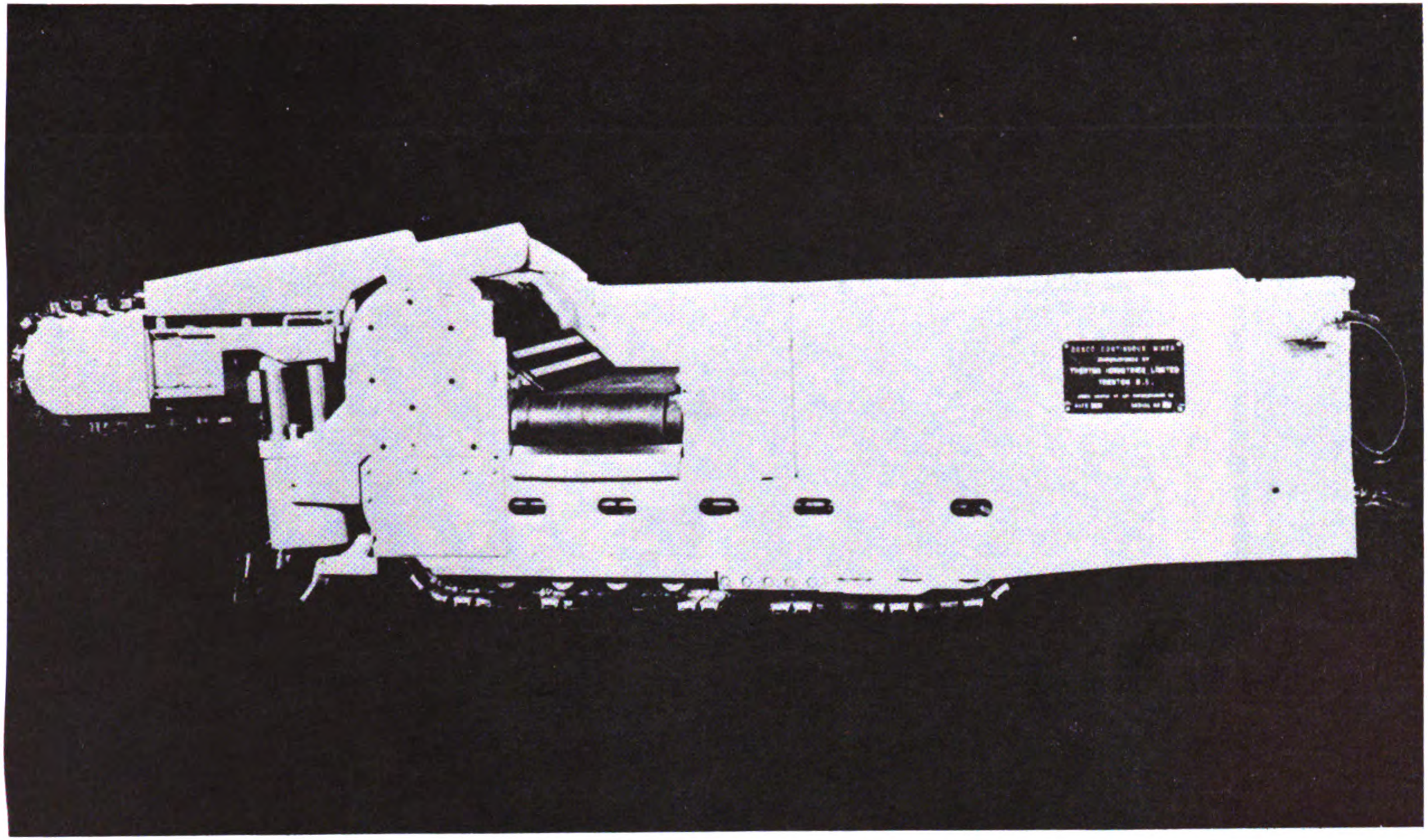

Figure 3. - Side view of Dosco continuous miner showing transverse belt that discharges mined coal.

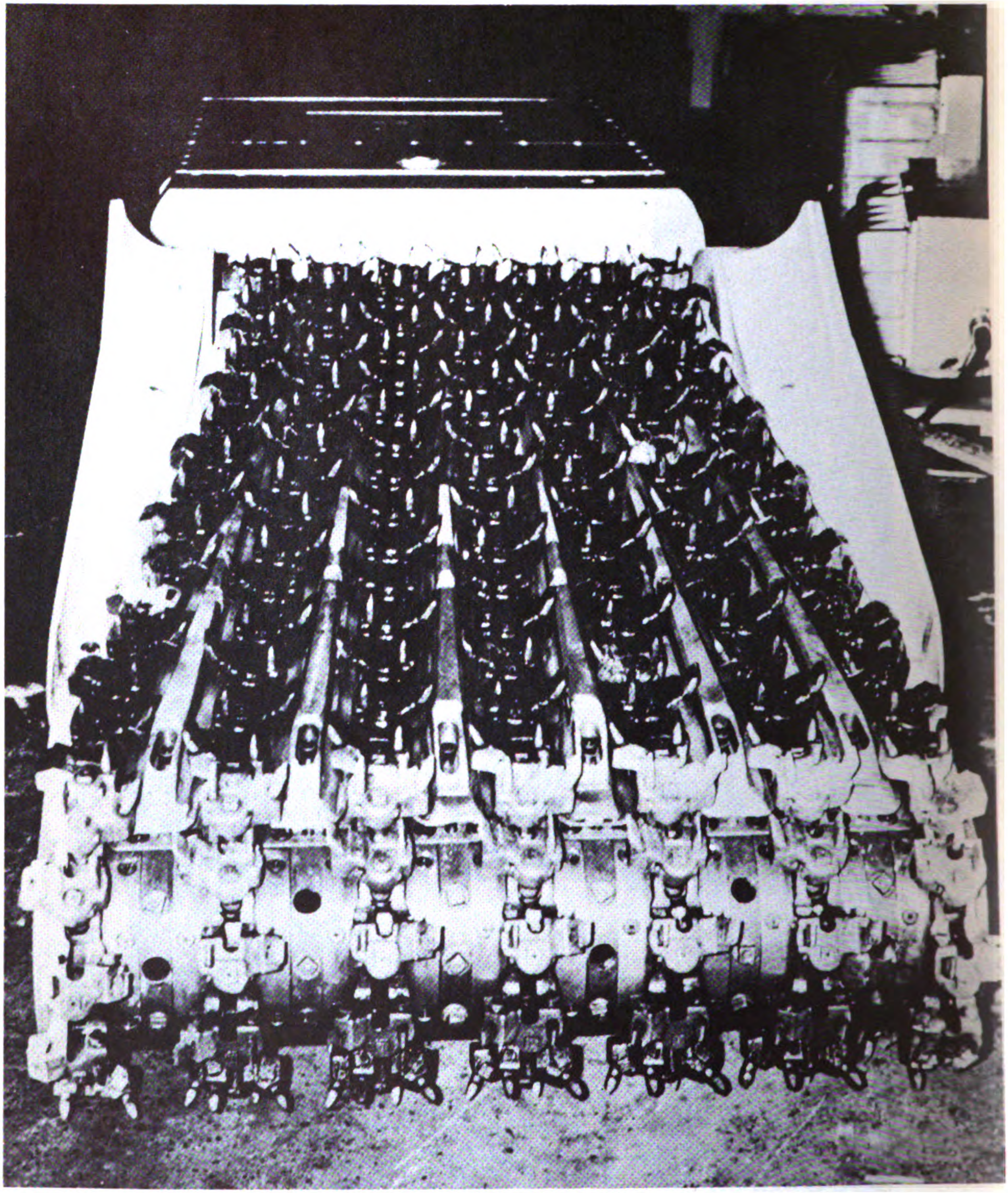

Figure 4. - Front view of continuous miner cutting head.

Face Conveyor

A 30-inch belt conveyor, operated at a speed of 350 feet per minute, receives the coal discharged by transverse belt of the machine and transports it down the pitch to a track-mounted belt conveyor, which discharges the coal into mine cars. A fast-moving armored chain conveyor, 24 inches wide, soon will replace this belt.

Roof Supports

The roof between the gob and the face is supported by wood bars, posts, cribs equipped with releases, and packwalls. In the haulageways, the roof supports are packwalls and steel arches lagged with timber.

CYCLE OF OPERATION

Figure 5 is a sketch of 1 of the 500-foot longwall faces. At the beginning of a cycle of operation, the mining machine is in a stall at the top of the face. The stall has been prepared by three men and an undercutting machine. As the stall extends up the face beyond the belt drive, the coal is hand loaded onto the belt. Where a number of adjacent faces are working, if the upper face is kept 10 feet in advance of the next lower face, the stall is made by the Dosco miner. The mining machine is operated down the dip, sumping the cutter head into the coal 18 inches and elevating the head so that each forward movement of the machine mines a block of coal 5 feet wide, 5 feet high, and 18 inches long. Some impure roof coal is left unmined to prevent spalling of the shale above the coal bed. The operation is repeated until the entire length of the face is mined. The mined coal is discharged by the transverse belt on the mining machine onto a 30-inch belt conveyor, which transports it down to the haulage entry where it is discharged onto a track-mounted conveyor mine car loader. A short chain conveyor is moved into place when the mining machine nears the lower end of the face to convey the coal, which is mined below the mine-car loader, up to the mine-car loader. Mining of the 500-foot face is scheduled for completion at the end of the first or production shift. On the second shift, the machine is trammed up the face and placed in the prepared stall for the next production shift.

On the third shift, the belt is moved 5 feet laterally to a new position 12 inches from the face ready for the next production shift.

As the mining machine advances down the face, 6-inch, round wood bars are set on 5-foot centers. One end of the bar is set in a hitch in the newly-mined face, and the other end is supported by a post set at the outby edge of the conveyor. The passageway between the conveyor and the new face is kept clear until the mining machine has been trammed into the stall for the next cut. After the machine has been returned to the starting stall, a post is set under the hitched end of each bar and about 6 inches from the coal. The bar then is partly sawed (between this post and the hitched end) so that when the mining machine makes the next cut, the end of the bar is broken without disturbing the bar or post. These timber sets are the only supports for the 9-foot opening between the newly mined face and the nearest crib line.

The main roof supports are two rows of cribs and midwalls (packwalls). Cribs are made with 6- by 6- by 30-inch hardwood blocks, and each crib is equipped with 2 crib releases. The cribs are on 10-foot centers in each row, but the rows are on 5-foot centers. (See fig. 5.) Midwalls are made from waste timbers and rock and are 12 feet wide on 50-foot centers. The midwalls are extended, and the row of cribs next to the gob are collapsed and moved ahead on the third shift.

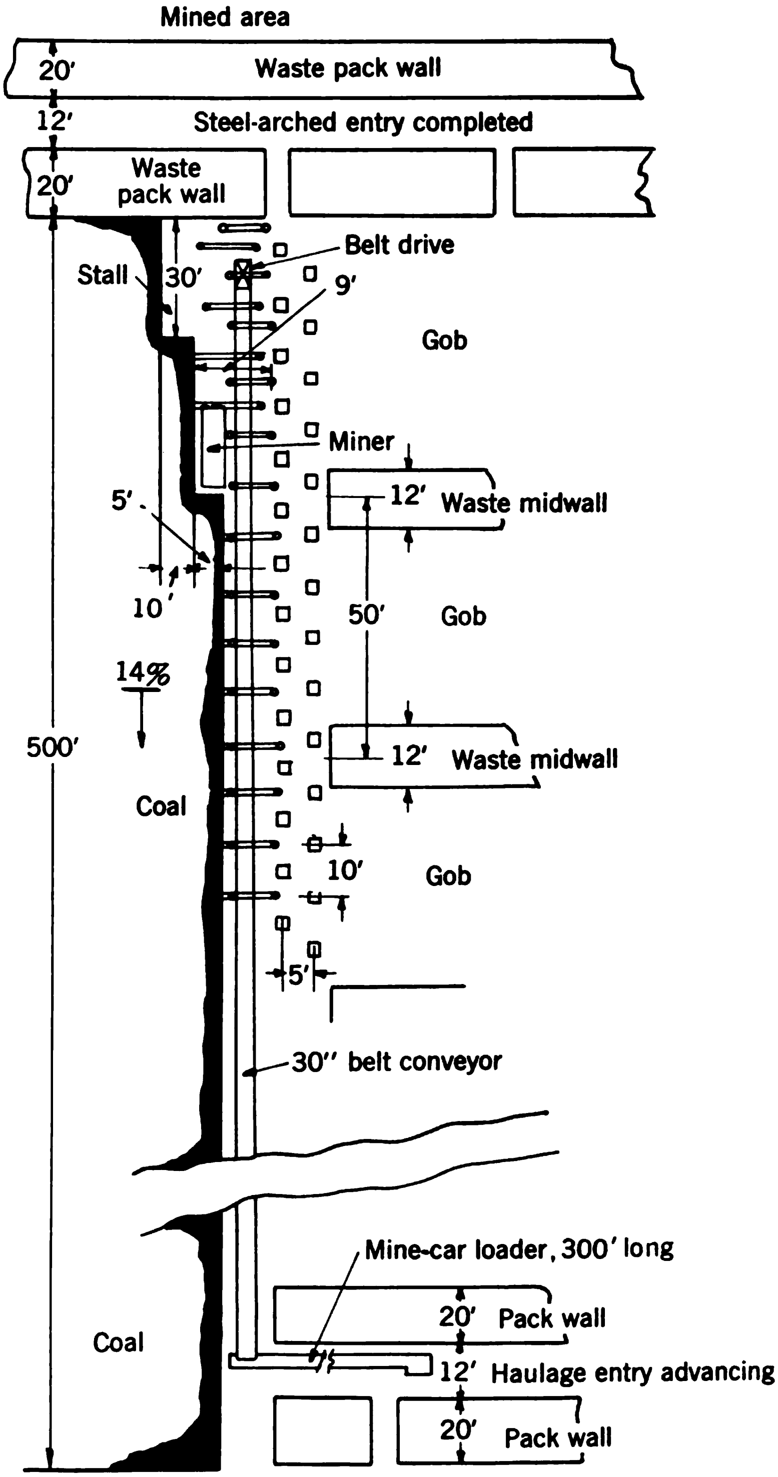

Figure 5. - Plan of mining a 500-foot longwall face.

The haulage entries are initially brushed at the face; from 3 to 4 feet of roof being taken in this initial brushing. Back brushing is kept about 250 feet outby the face in the haulage entry to permit the erection of rigid steel arches 10 feet high at the crown and 12 feet wide (inside dimensions). The arches are set on 3-foot centers. Roof bolts are used instead of arches where shale does not weather too badly. Five 8-foot bolts are used in each row. Ribs are bolted generally with 4-foot bolts using 3- by 6- by 30-inch hardwood bearing plates.

A detailed job classification of facemen is not included in this report because the classification for mining flat-lying beds in the United States would differ appreciably. In an application of this type machine to longwall mining in flat-lying coal beds, it is visualized that a retreating longwall system would be employed.

POSSIBLE USE OF THIS MACHINE IN FLAT-LYING COAL BEDS

Recent experiences have been successful in retreating longwall mining in the United States with European longwall machines. The German coal planer has been the most successful machine, especially in mining friable coal where the bed parts freely from the top and bottom. If the coal is medium-hard to hard or the top or bottom is frozen to the coal bed, the planer cannot be operated with maximum efficiency. Either there will be a lower rate of production or an increase needed in the number of men at the face to perform extra work caused by these conditions. The Dosco continuous miner is producing coal at a high rate under the very conditions that have been determined to limit the operation of planers.

It has been established that the Dosco continuous miner can mine medium-hard coal on a longwall face under mining conditions more difficult than found ordinarily in the United States. It is designed to cut coal in either direction across a longwall face. So far as could be determined, the mechanical defects of the machine, which are characteristic of any new development, have been overcome and a minimum of maintenance is required. A retreating longwall face in a flat-lying coal bed should present ideal conditions for operating the Dosco continuous miner. It is believed under these conditions the rate of production from the Dosco continuous miner will equal that of other types of continuous-mining machines now used in bituminous-coal mines. In addition, the retreating longwall method of mining should effect a larger percentage recovery of coal.

The adaptation of the Dosco-type machine to mining conditions in the United States and the choice of a roof-control plan and conveying system are problems that must be solved for each application. A proposed plan of operation is shown in figure 6. Assume a coal bed 5 feet thick, a longwall face 500 feet long, two coal-producing shifts per day, and a desired production of 1,000 tons per day: It is estimated that 46 men would be required. The following is a suggested job classification for the crew:

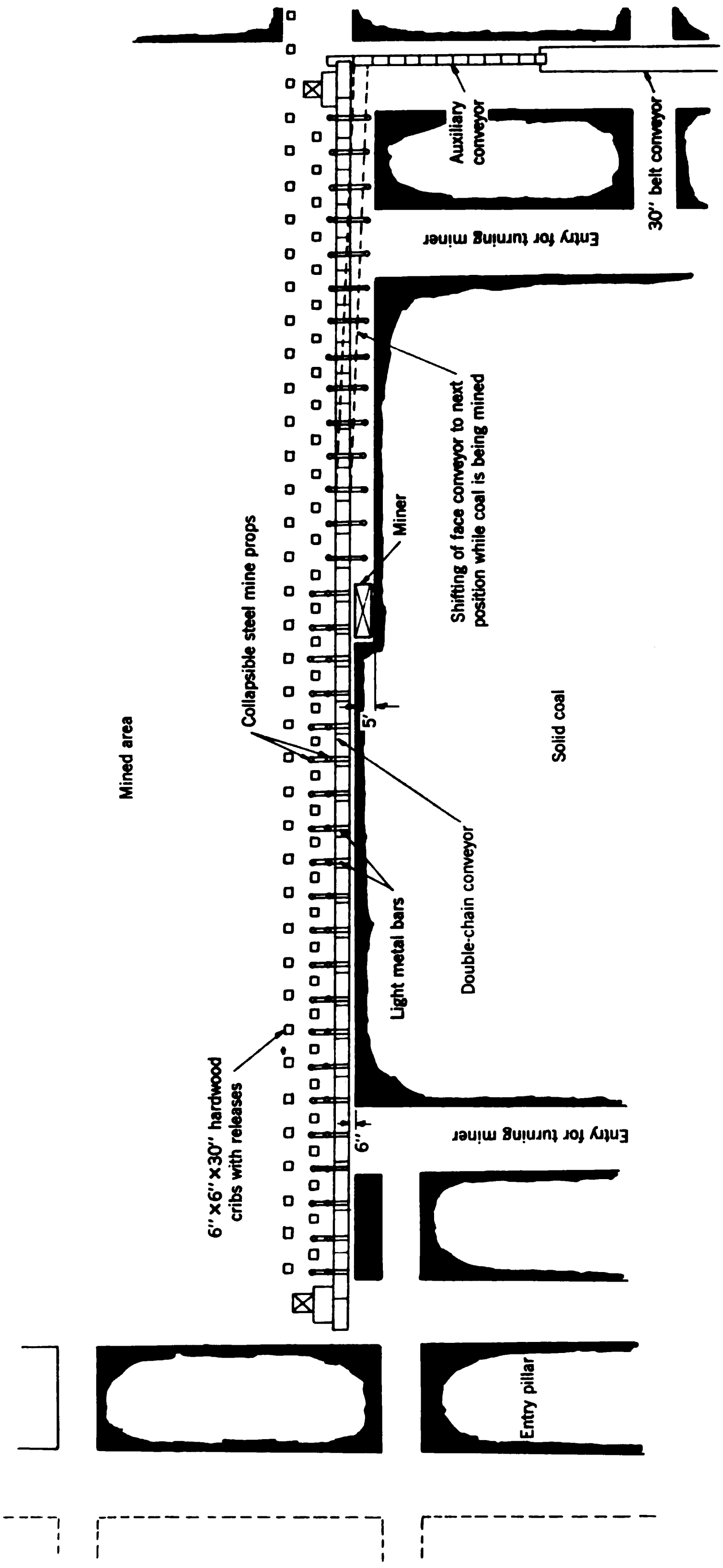

Figure 6. - A suggested plan for longwall mining in a flat lying bed.

Suggested job classification	Shift 1st	 2d	 3d
Foremen	1	1	1
Dosco operators	1	1	-
Cleanup men	1	1	-
Timbermen at machine	2	2	-
Crib men	6	6	6
Headpiece men	1	1	-
Conveyor shifters	2	2	-
Mechanics	1	1	1
Boom men	1	1	-
Belt men	2	2	-
Supply men	-	-	2
Total	18	18	10

SUMMARY AND CONCLUSIONS

In the interest of conservation of valuable natural resources, which have been and are still being wasted by conventional mining methods, operators of coal mines who are interested in conservation as well as economical mining are urged to study the possibilities of longwall mining with a continuous-mining machine.

It is readily acknowledged that for room-and-pillar work, as generally practiced in the United States, and where little thought has been given to the merit of total extraction as compared to economical mining, this machine has little to offer; but for the operator whose coal resources are being depleted rapidly, the advantages may be great.

Although the plan of operations adopted where the machines are now used does not take advantage of mining in either direction, this is entirely feasible especially in the United States where the coal beds lie flat, generally. Retreat longwall mining in the flat-lying beds in the United States should offer greater possibilities of economy than the advancing longwall system.